Temporary Balloon Occlusion during Giant Aneurysm Surgery

A Technical Description

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Summary

We propose this combined balloon occlusion and surgical technique to treat selected patients with large-giant aneurysms not suitable for a pure endovascular or surgical approach.

After an occlusion test a non detachable balloon catheter is positioned deflated proximally to the neck of the aneurysm under general anesthesia. The patient is then moved to the neurosurgical room. During the intervention the balloon is inflated and deflated when necessary to allow better surgical control of the aneurysmal sac. With this approach we achieve complete aneurysm occlusion and shorten the surgery time. Since January 2003 we have treated 13 giant aneurysms (ten paraclinoid and three vertebrobasilar) without significant complications related to balloon assistance and a good outcome in all patients.

Introduction

The management of giant aneurysms has always been a challenge [1]. Several approaches are possible [2,3] including endovascular occlusion (direct coil or parental vessel occlusion) for infraclinoid aneurysms or pure surgery in supraclinoid aneurysms with clipping or by-pass.

For giant vertebrobasilar aneurysms direct vessel occlusion or coil placement are widely used therapeutic alternatives to surgery [8,10]. In any case, surgery of a giant sac is a high risk procedure, because of the possibility of bleeding with difficult or impossible control on the proximal part due to the large aneurysmal sac. Furthermore, without a good control on the sac there is a risk of occluding parent vessels.

We have developed a simple technique of temporary balloon occlusion during a neurosurgical approach to treat large paraclinoid and vertebrobasilar aneurysms where the proximal part of the artery is not directly reachable because of the large sac.

Material and methods

From January 2003 to September 2005 we treated ten patients with giant paraclinoid aneurysms of the internal carotid artery and three patients with giant aneurysms of the vertebrobasilar systems. The aneurysms were occasional findings in 12 patients referred for several clinical conditions such as headache, seizures or cranial nerve compression. One posterior circulation aneurysm had been previously treated by surgery at another institution for a slight bleed with a giant partially thrombosed aneurysm.

Technical description

All patients were studied with MRI and angiography. Diagnostic angiography is always completed with an occlusion test [4] using a flow dependent balloon catheter. Particular atten-

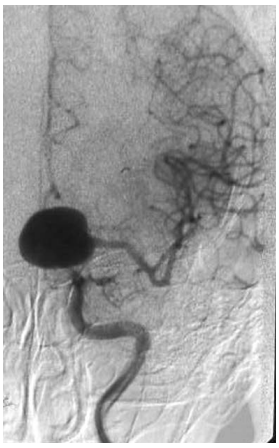
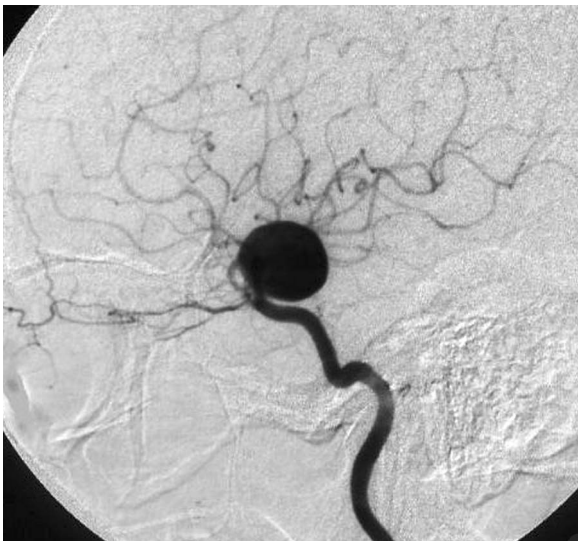


Figure 1 Giant left internal carotid paraclinoid aneurysm: diagnostic procedure in AP and LL views. Non detachable flow directed balloon positioning just below the ophthalmic artery before neurosurgery approach.



tion is paid to the collateral circulation and the venous drainage in both hemispheres. After data collection informed consent to the combined approach is requested.

Endovascular procedure

Under general anesthesia, a femoral approach with a 7 F. sheath is the preliminary step and a 7 F. guiding catheter is positioned in the first internal carotid section. A non detachable flow dependent balloon catheter (Balt B1, Balt Extrusion, 95160 Montmorency, France) is positioned in the intracavernous segment or below the ophthalmic artery (figure 1) in the same segment as the previous occlusion test. In vertebrobasilar aneurysms we position the guiding catheter in the first part of vertebral artery to avoid vasospasm: the balloon catheter is then pushed below the neck into the basilar or vertebral artery (figure 3). A double balloon catheter approach in the basilar and posterior cerebral artery is sometimes necessary to control blood flow in giant aneurysms of the distal basilar section. We prefer flow directed catheters because of the low thromboembolic risk with respect to over-the-wire balloon catheters even if the latter have a better positioning accuracy.

We check the flow directed balloon position and the inflation and deflation times several times. A 3000 U.I. heparin bolus is injected during the start of the procedure so as not to increase the risk of bleeding during the subsequent craniotomy. We prefer a good flow control of the guiding catheter washing solution with heparin saline (5000 U.I. /liter) during balloon placement and the following surgical approach.

When the best balloon position is reached we check the inflation and deflation times and the balloon flow movements. Then we move the patient with the complete arterial femoral system to the neurosurgery room: particular attention is paid not only to keeping the double coaxial system guiding catheter-balloon catheters sterile but also to checking the good flow saline washing pressure. Patient transfer is a delicate part of the procedure and the double guiding catheter-balloon catheter system must be fixed as well as possible to avoid balloon displacement. Balloon placement can be checked again in the neurosurgical theatre with portable fluoroscopy before positioning the patient's head.

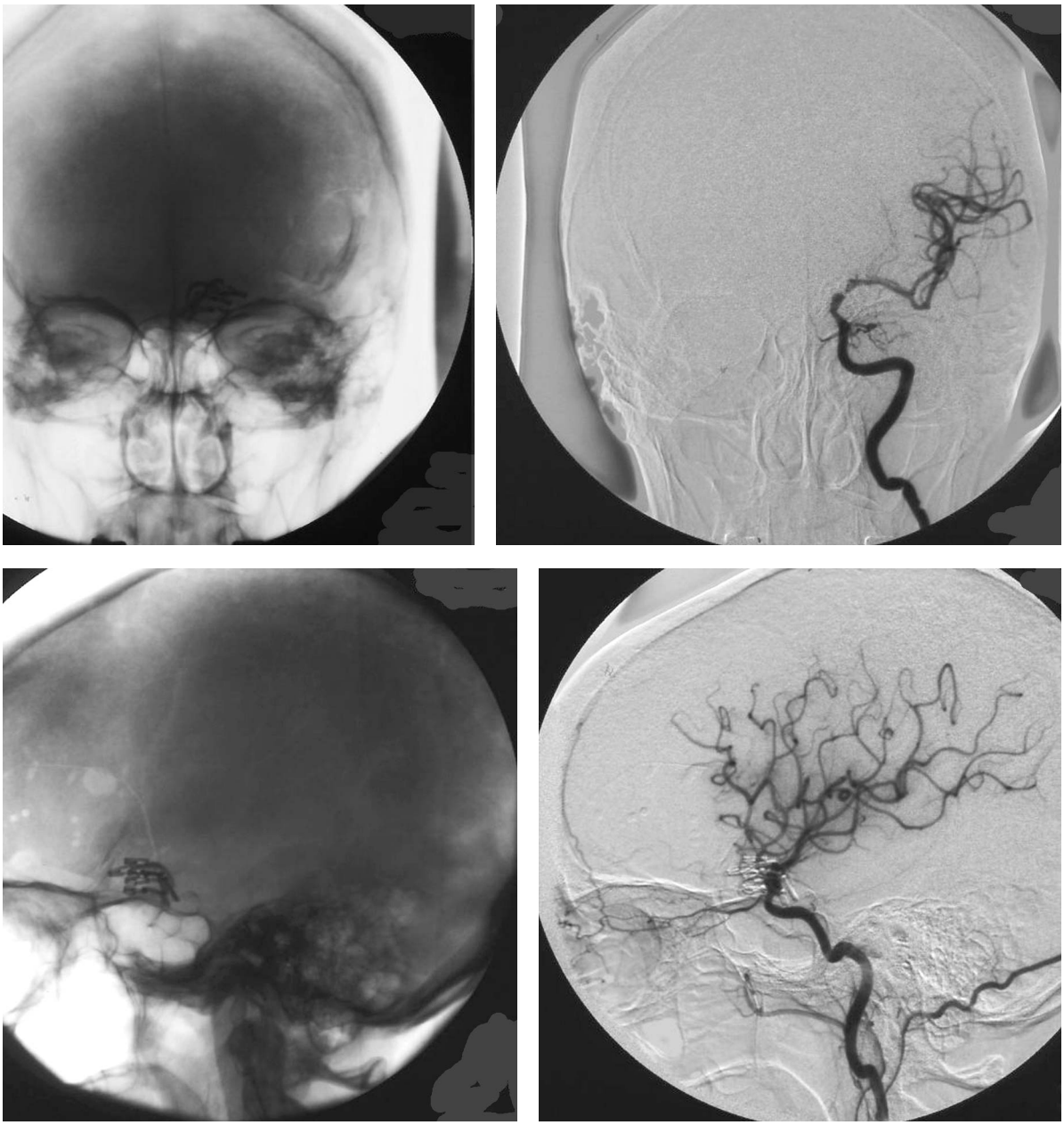


Figure 2 Same case: post surgical control with clips positioning and aneurysm exclusion.

Surgical time

During surgical intervention it is necessary to inflate the balloon when required. Inflation time is no longer than five minutes. Carotid occlusion is verified by slight deflation and detention of the aneurysm. Generally, no more than three or four balloon inflations are required for a total of 15 – 20 minutes occlusion time.

Angiographic control with portable fluoroscopy is necessary at the end of the procedure. Then the balloon and the guiding catheter are removed. In all patients the entire combined procedure time requires no longer than five to six hours.

Results

In all our thirteen cases, ten paraclinoid carotid and three vertebrobasilar giant aneurysms, we applied this temporary balloon occlu-

Figure 3 Partially thrombosed giant basilar aneurysm. Diagnostic angiography and basilar test occlusion: note a partial aneurysmal refill via the right posterior communicating artery. Balloon position (arrow) in the basilar artery in the diagnostic work-up and during surgical clipping.

sion technique with good results. All aneurysms were excluded with parent vessel patency (figure 2). All neurological onset symptoms decreased in paraclinoid aneurysms and in two basilar artery aneurysms within three weeks whereas they remained unchanged in one patient with a basilar artery aneurysm. Balloon rupture (over-the-wire remodeling balloon) occurred at the last inflation in one patient with no significant incidence on the surgical strategy. For this reason and due to the lower thromboembolic risk we prefer to use a latex flow de-

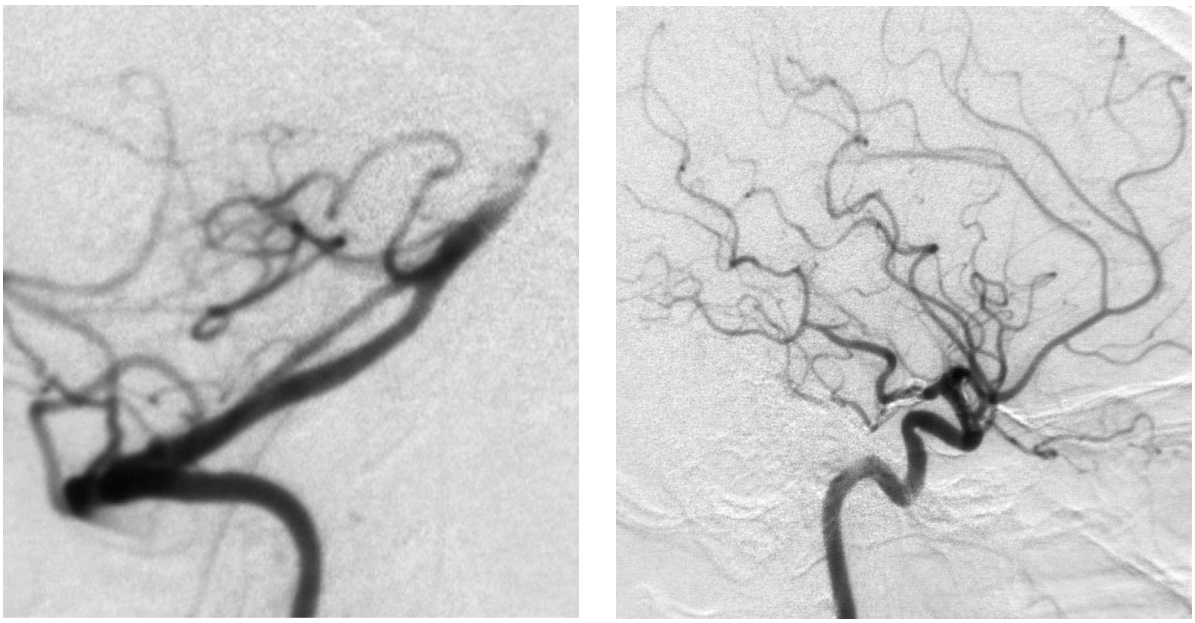


Figure 4 Post surgery angiographic control: complete exclusion and symptomatic improvement.

pendence balloon catheter. In one paraclinoid case a slight recurrence one year after surgery required a coil embolization without clinical changes. No embolic complications due to balloon occlusion were observed.

Discussion

Is well known that giant paraclinoid aneurysms often require flow control, sometimes with retrograde catheter aspiration [5,6,9,12,14,15]. Balloon decompression is not frequently used even though it has been described since 1993 [13]. Previously published results encouraged us to improve this technique.

Balloon assistance surgery should be considered a good technique, especially as an alternative to direct arterial occlusion, for possible early intracranial vascular complications. Direct coil occlusion in giant aneurysms, even with stent or remodeling assistance, presents a high recanalization rate and unsatisfactory stable results. Liquid embolic treatment, a relatively new technique, is more complicated and a recent review of results did not give stable results [11,16].

We suggest this combined approach for all giant aneurysms in which direct embolization or pure surgery does not yield a stable long-term outcome. With this technique is possible to achieve mass effect exclusion and a stable angiographic result. Direct endovascular approach seems elective in all poor grade patients or patients not suitable for open surgery.

Our results are in line with other similar experiences [5,7], especially improving the aneurysm occlusion rate with no significant complications due to balloon inflation. We believe that flow direct balloon occlusion is significantly less traumatic even for a long combined surgical-endovascular procedure.

Conclusions

Our preliminary experience shows that our combined balloon occlusion and surgical technique is safe and feasible in selected patients with large-giant aneurysms. A perfect occlusion tolerance test and a good collateral flow circulation anatomy seem to be essential conditions for a final optimal result.

The combined approach is a major aid to the neurosurgeon for a safer procedure with better manipulation of the aneurysmal sac and an improved control of the collateral circulation. Accurate flow control of the catheter washing heparin saline solution seems the easiest way to avoid embolic complications.

Routine cooperation with the Neurosurgery Unit is essential.

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